Why Nanobiotechnology?

Dr. Laura Mazzola

The NanoBiotechnology Forum

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Why nanobiotechnology?

We need to gauge our internal and external environment at the molecular scale.

New materials, small sizes:

- Nanoscale fabrication techniques
- Comparable to molecular dimensions
- Convergence of micro and nano-scales

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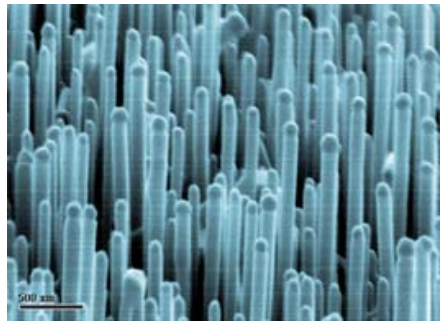

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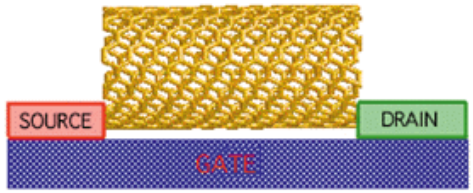
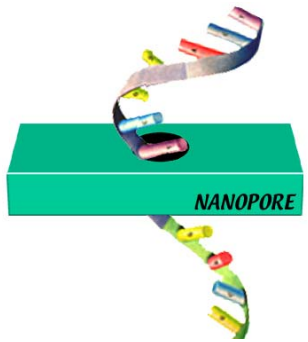
Key features:

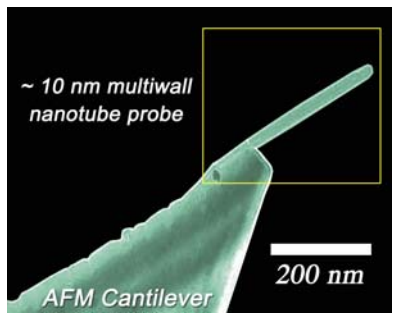
- Underlying technology from material science
  - Particles, crystals, dots, spheres, tubes, wires → *nanotech*
  - Proteins, genes, viruses → *biotech*



- Interface biology at the molecular level
  - In-situ or in-vivo analysis
  - Convergence toward seamless integration

- Unprecedented sensitivity





Source: NASA-Ames

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Areas of application: *It's the product, stupid!*

Bioanalysis: high-throughput screens, biosensors

Therapeutics: drugs & drug delivery, pre-clinical screening

Medical devices: implants, sensors, contrast & shielding agents, surgical techniques

Integrated devices: sense, diagnose & deliver therapeutics

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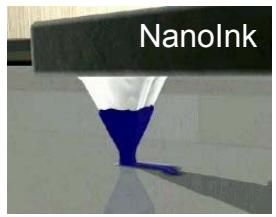
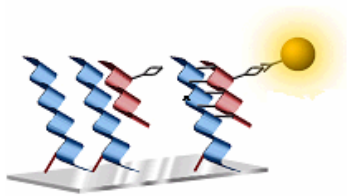
Bioanalysis

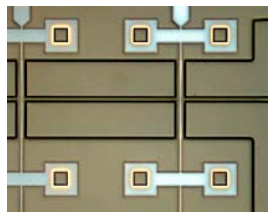
HTP screens, sensors & diagnostic platforms:

- Multiplexed assays in solution: dots, bars, beads
- Arrays by deposition: beads, particles, wires
- Nanopore transport (sequencing, ion channels)
- Microfluidics to nanofluidics

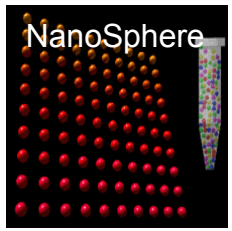


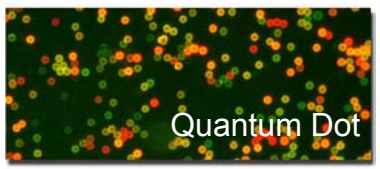


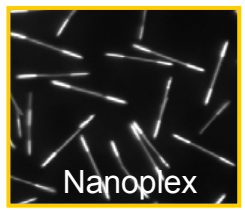
Genicon

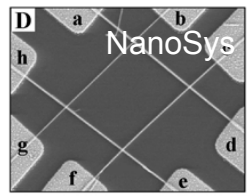


H. Criaghead, Cornell









→ Novel detection leads to enhanced sensitivity

→ Higher throughput is nice, but multiplexed format is key

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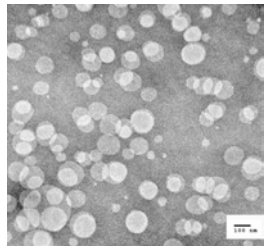
Therapeutics

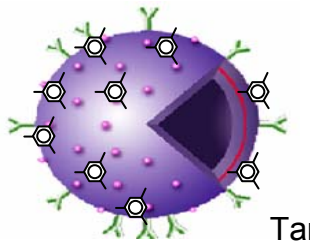


NanoMed

Drugs & drug delivery platforms:

Drugs with enhanced bioavailability & specificity

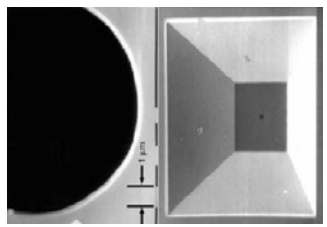
- Improve drugs with poor solubility
- Traverse membranes, possibly blood-brain barrier
- Delivery of nanostructured silicon for bone structure



Targesome

Drug delivery systems

- Delivery via skin, GI tract, vacsular system
- Encapsulation for "stealth-mode" release
- Encapsulation for scavenging/removal
- Devices for long-term *in vivo* delivery
- Wound dressing



iMEDD

Tissue-specific payload deposition

- High local dose
- Lower toxicity & side effects
- Slower clearance

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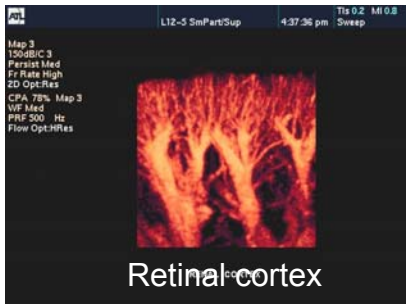
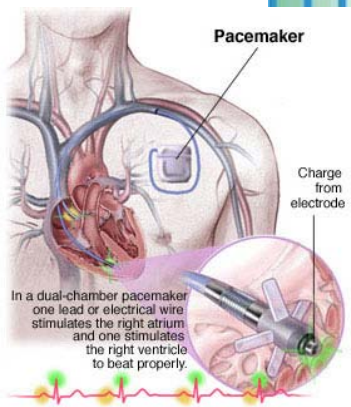
Medical Devices

Medical imaging:

- Contrast agents
- Shielding agents
- Tissue-specific image enhancement

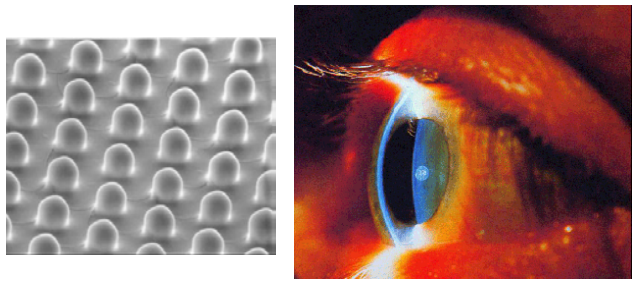




BioPhan: MRI compatible coatings

Implantable sensors:

- Retinal processing
- Neural interconnects
- Stents with drug delivery and active monitoring



Stanford Vision Chip: retinal implants

Nanoscale Surgery:

- Tissue-directed light/heat ablation
- Cell-specific gene therapy

Atherosclerotic Coronary Disease

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Nanobiotechnology – development timeframe

Immediate term	Near term (3-5 years)	Longer term (5+ years)
New tools	**New materials**	**CV monitoring**
Drug delivery	**Nanowire arrays**	**Nanosurgery**
(bioavailability)	**Drug delivery**	**Retinal Therapeutics**
HTP screens	("stealth-mode")	**Neural growth matrix**
(dots, bars, beads)	**Contrast agents**	
Shielding agents	**GI monitoring**	
Bone growth matrix	***In situ* cell analysis**	

Far out: Integrated, implantable devices

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The Innovation Dilemma – How to cross the chasm?

Is there an optimal way to develop this early-stage technology?

Biotech has been there, done that:

- Good models for spin-outs & strategic partnering
- Demonstrated scaleable, sustainable growth (in some areas)
- Biotech investors have patience!

Leverage what worked (or didn't work) with biotech:

- Cutting-edge technologies, high risk vs. high value
- Strong IP positioning
- Develop strategic relationships to a more established industry
- Product, product, product – and revenue!
- Manage the hype and the inevitable backlash

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How to get there?

Bootstrapping Model:

- Leverage university relationships
- Tap into regional nanotech alliances
- Government grants (SBIR, DARPA)
- Family & friends
- Angel funds
- Partnership milestones with limited capital

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"Look in your rear view mirror for oncoming trucks"

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Thank You

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